SD11
U7R62
-36

FOREST PEST MANAGEMENT

A SUMMARY OF DWARF MISTLETOE PROGRAM ACTIVITIES IN THE ROCKY MOUNTAIN REGION--1970-1986

LIBRARY
AUG 25 1986
ROCKY MOUNTAIN STATION

United States Department of Agriculture

Forest Service

Forest Pest Management
Denver, Colorado

A SUMMARY OF DWARF MISTLETOE PROGRAM ACTIVITIES IN THE ROCKY MOUNTAIN REGION--1970-1986

by
David W. Johnson
Supervisory Plant Pathologist

Technical Report R2-36
July 1986

Timber, Forest Pest, and
Cooperative Forestry Management
Rocky Mountain Region
USDA, Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

LIBRARY COPY
ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

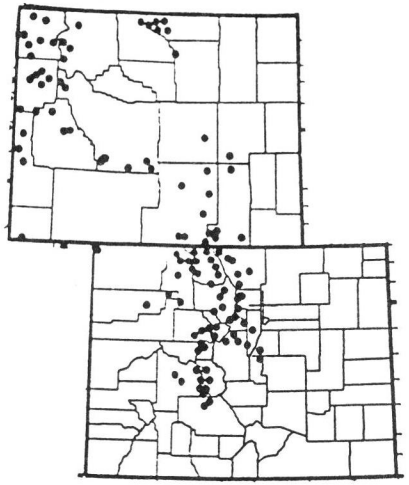
A SUMMARY OF DWARF MISTLETOE PROGRAM ACTIVITIES IN THE ROCKY MOUNTAIN REGION--1970-1986

Scope of the Dwarf Mistletoe Problem

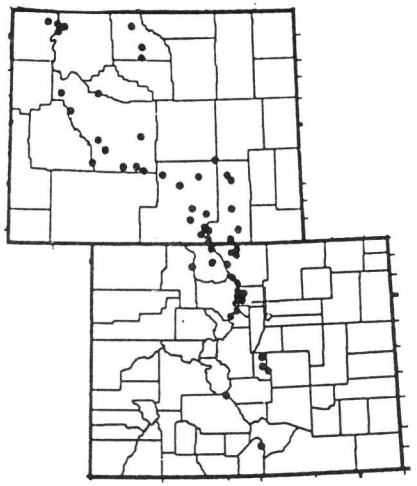
Dwarf mistletoes, Arceuthobium species, are the most damaging disease agents of conifers in the western United States. Annual growth loss and mortality from these parasitic plants has been estimated at over 393 million cubic feet. Although several species of Arceuthobium are present in the Rocky Mountain Region (Table 1), only A. americanum (lodgepole pine dwarf mistletoe and A. vaginatum subspecies cryptopodum (Southwestern dwarf mistletoe) are considered to be of management concern. In some areas A. douglasii (Douglas-fir dwarf mistletoe) is important. Maps that show the distribution of the species in the Region are presented in Figure 1. Estimates of the percentage and acreage of lodgepole pine and ponderosa pine type infested by Forest are presented in Table 2. Combined merchantable losses to these mistletoes is estimated at over 10 million cubic feet annually for National Forest lands alone in this Region.

Table 1: Principal hosts and general distribution of dwarf mistletoe species in the Rocky Mountain Region

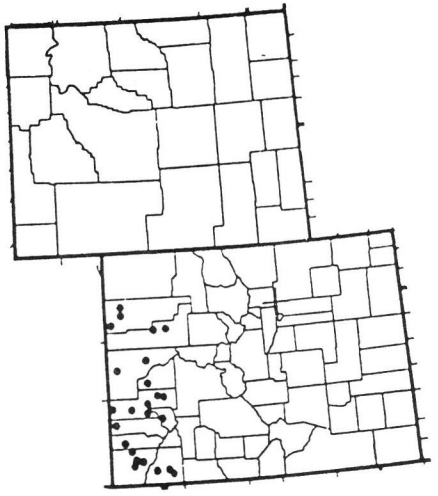
Dwarf mistletoe species	Principal hosts	Distribution
Arceuthobium americanum	Lodgepole pine; occasional cross-over to ponderosa pine	Colo., Wyo.
A. cyanocarpum	Limber pine, white bark pine	Colo., Wyo.
A. divaricatum	Pinyon	W. Wyo.
A. douglasii	Douglas-fir	Colo., W. Wyo.
A. vaginatum subsp. cryptopodum	Ponderosa pine	Colo.



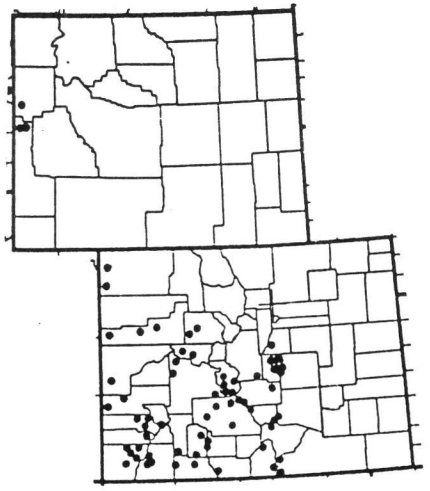
a. A. americanum



b. A. cyanocarpum



c. A. divaricatum



d. A. douglasii

e. A. vaginatum subspecies cryptopodum

Figure 1. Distribution of Arceuthobium species in Region 2.

Table 2: Incidence of *Arceuthobium americanum* and *A. vaginatum* subsp. *cryptopodum* in Rocky Mountain National Forests

National Forest	*A. americanum* Acres Infested %	*A. americanum* Acres Infested No.	*A. vaginatum* Acres Infested %	*A. vaginatum* Acres Infested No.
Colorado				
Arapaho/Roosevelt	48	220,900	19	18,100
Grand Mesa/Uncompahgre and Gunnison	52	77,200	4	3,000
Pike and San Isabel	43	76,600	20	53,400
Rio Grande	0	0	1/	1/
Routt	52	90,500	0	0
San Juan	0	0	21	45,500
White River	36	52,200	0	0
Wyoming				
Bighorn	36	51,000	0	0
Medicine Bow	60	193,000	0	0
Shoshone	64	81,000	0	0
Totals	49	842,400	16	120,000

1/ This dwarf mistletoe occurs in the Forest, but was not recorded in surveys.

Dwarf Mistletoe Program Emphasis and Benefits

The emphasis of the program in the Region has been on locating and defining those management units where infected non-merchantable overstory trees were left standing in older timber sales and pose a threat to established regeneration. In many cases these young stands will not reach merchantable size if the infected residual trees are not felled or removed.

The dwarf mistletoes are most easily and economically treated by silvicultural practices. Several features of these parasites make them ideal candidates for cultural treatment:

- The dwarf mistletoes are obligate parasites; that is they require a living host to survive. Once an infected tree or branch is cut, the mistletoe dies. There is no need to destroy the slash.

- They are generally host specific; that is they are usually confined to a single host species or group of closely related species. Immune or resistant species can be favored during stand treatments.

- Their life cycles are relatively longer than other tree disease organisms. The development of mature mistletoe plants from seeds takes two to eight years. From a practical standpoint, these long life cycles mean that the amount of infection increases relatively slowly. If a stand is properly treated, dwarf mistletoe should not be a problem in subsequent rotations.

- Dwarf mistletoes spread slowly through stands. Seed dispersal is usually limited to less than 60 feet from a tall isolated tree. In even-aged stands, spread is even more limited averaging one to two feet per year.

- Infected trees and stands are easy to detect because of the presence of dwarf mistletoe plants, branch and stem swellings, and witches' brooms. Heavily infested stands show decline and mortality. Detailed surveys are an essential ingredient of successful control programs. Several survey methods have been developed to determine the distribution and intensity of infection. Whenever possible, surveys should be integrated into standard inventory procedures.

Presuppression surveys are utilized to define areas in need of treatment. Once the resource manager has located general problem areas and requested assistance from Forest Pest Management (FPM), plant pathologists schedule service trips to evaluate the biological need and effectiveness of proposed suppression projects. Forest stand yield simulation models, RMYLD, enable the manager to project the current forest stand with existing dwarf mistletoe infection levels and compare several treatments for effectiveness in reducing infection levels and increasing productivity of the stand. The priority of several stands for treatment can then be decided by comparing projections for each stand.

Other activities include the sanitation-thinning of lightly infested precommercial size stands and the replacement of severely infested stands by clearcutting or prescribed burns.

Dwarf mistletoe suppression yields multiple benefits including:

1. Dwarf mistletoe infection delays the economic maturity of stands, adversely affecting wood quality and tree seed production. Dwarf mistletoe suppression is necessary to insure increased productivity of stands in the future to meet the increased demand for wood products.

2. Dwarf mistletoe suppression is necessary to protect other forestry investments, such as site preparation, tree planting, thinning and timber stand improvement. In addition, dwarf mistletoe control in infested stands prevents spread of the disease to adjacent healthy stands.

3. Dwarf mistletoe suppression results in increased productivity per acre and under intensive management results in reduced acreage needed to meet timber targets. In this manner we can concentrate harvesting activities on fewer acres at a reduced cost. With the trend of withdrawal of forest land from timber production and harvesting, it is imperative that we increase the productivity of the remaining commercial forest stands.

4. Dwarf mistletoe suppression reduces the susceptibility of stands to insect attack, particularly bark beetles, windthrow and natural fires.

5. The silvicultural procedures developed for dwarf mistletoe suppression have been proven to be very effective and provide control of the disease for the current and subsequent rotations.

Dwarf Mistletoe Program Expenditures and Accomplishments

Since 1970, the Rocky Mountain Region has surveyed over 266,000 acres and treated 32,000 acres at a cost of $2.2 million (Table 3). A summary by National Forest is presented in Table 4. Detailed listings for each Forest by year are included in the Appendix (Tables 5-12). Expenditures have been rounded. These summaries only include projects in which FPM was directly involved. Many more acres of control were accomplished through timber harvests and other stand entries, however, we have no record of the acres treated. The FPM program consists of presuppression surveys, overstory removal, thinning and sanitation and stand replacement. Since 1980, the program has received greater support and emphasis. Five year planning documents have been prepared by several Forests and activities and funding requests have been integrated into the Forest planning and budgeting process. This strategy has insured a more continuous source of funding and program continuation than in the past, also resource managers can more effectively schedule time, resources and manpower.

Table 3: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments, Rocky Mountain Region--1970-1986.

Fiscal Year [1/]	FPM $[2/]	Acres Surveyed	Acres Treated
1970	-	-	639
1971	-	1,300	1,484
1972	-	4,000	1,376
1973	-	10,000	800
1974	-	25,000	-
1975	-	25,000	-
1978	-	9,000	262
1979	19,400	512	512
1980	69,600	27,306	693
1981	153,800	18,500	2,520
1982	226,500	47,197	4,278
1983[3/]	745,400	11,825	6,268
1984	310,000	11,550	5,220
1985[4/]	380,000	52,127	5,504
1986	288,800	23,000	2,410
Totals	2,193,500	266,317	31,966

1/ No program in 1976 or 1977.
2/ Records unavailable for years 1970-1978.
3/ Includes Jobs Bill funding.
4/ Includes TSI funding.

Table 4: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments Listed by National Forest, Rocky Mountain Region--1979-1986.

Forest	FPM $[1/]	Acres Surveyed	Acres Treated
Arapaho/Roosevelt	598,900	74,000	9,386
Grand Mesa/Uncompahgre/ Gunnison	219,600	17,693	2,702
Medicine Bow	502,400	17,700	7,970
Rio Grande	27,300	2,916	390
Routt	247,100	24,000	2,300
Pike/San Isabel	187,000	38,616	392
Shoshone	214,900	8,392	2,515
White River	196,300	8,700	1,750
Totals	2,193,500	192,017	27,405

[1/] Includes Jobs Bill and TSI funds for years 1983, 1985.

Recommendations for the Future

Now that the backlog of overstory removal projects is completed, it is essential that future harvesting activity be directed at preventative measures for dwarf mistletoe control. It is much more efficient to prevent mistletoe from becoming established than to treat or replace severely infested stands. Suppression activities should be an integral part of good forest management and practiced as a part of normal stand management. Subsequently less reliance on FPM funds will occur in the future. Specific recommendations for future programs include:

1. Encourage Forests to complete site-specific dwarf mistletoe suppression plans based on existing presuppression survey data and other inventory data.

2. Insure that contract specifications for felling of non-merchantable infected trees be followed in timber sales.

3. Treat infested stands bordering sanitized stands. Prevent reinvasion of regenerated clearcuts from adjacent untreated stands.

4. Treat infested stands through planned sales, other stand entries whenever possible.

5. Emphasize control of the disease at final harvest and site preparation and ensure that infection is eliminated in regenerated stands.

6. Continue training programs that emphasize integration of pest management and good silviculture as the least-cost, most effective control of forest pests.

A complete chronological listing of service trips, biological evaluations and other technical reports on the dwarf mistletoe program for 1971 to 1985 are included in the Appendix.

Table 5: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Arapaho and Roosevelt National Forests (1980-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1980	8,700		2,600	186	
1981	61,000		14,000	1,100	
1982	111,900		31,100	3,685	
1983[1/]	-	(238,000)	-	-	(2,045)
1984	81,000		-	1,050	
1985	48,300		26,300	820	
1986	50,000		-	500	
Totals	360,900	(238,000)	74,000	7,341	(2,045)

[1/] Figures in parentheses funded by Jobs Bill.

Table 6: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Grand Mesa, Uncompahgre and Gunnison National Forests (1980-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1980	9,000		17,106	-	
1981	9,600		500	500	
1982	20,000		87	187	
1983[1/]	10,000	(56,000)	-	115	(300)
1984	45,000		-	600	
1985	35,000		-	500	
1986	35,000		-	500	
Totals	163,600	(56,000)	17,693	2,402	(300)

[1/] Figures in parenthesis funded by Jobs Bill.

Table 7: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Medicine Bow National Forest (1981-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1981	1,600		-	60	
1982	33,200		12,000	-	
1983[1/]	41,400	(155,000)	-	726	(782)
1984	95,300		600	2,800	
1985[2/]	83,900	(65,600)	5,100	3,102	
1986	26,500		-	500	
Totals	281,900	(220,600)	17,700	7,188	(782)

1/ Figures in parentheses funded by Jobs Bill.
2/ Figures in parentheses funded by TSI.

Table 8: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Rio Grande National Forest (1985-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1985[1/]	2,800	(4,500)	916	-	(90)
1986	20,000		2,000	300	
Totals	22,800	(4,500)	2,916	300	(90)

1/ Figures in parentheses funded by TSI.

Table 9: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Routt National Forest (1983-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1983[1/]	5,000	(68,000)	2,000	-	(680)
1984	51,700		8,000	520	
1985	83,900		10,000	800	
1986	38,500		4,000	300	
Totals	179,100	(68,000)	24,000	1,620	(680)

[1/] Figures in parentheses funded by Jobs Bill.

Table 10: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Pike and San Isabel National Forests (1982-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1982	10,300		830	50	
1983[1/]	25,000	(10,000)	9,825	-	(120)
1984	11,500		1,200	90	
1985	34,900		9,761	12	
1986	95,300		17,000	120	
Totals	177,000	(10,000)	38,616	272	(120)

[1/] Figures in parentheses funded by Jobs Bill.

Table 11: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the Shoshone National Forest (1979-86).

Fiscal Year	FPM $	Acres Surveyed	Acres Treated
1979	19,400	512	512
1980	51,900	7,600	507
1981	65,700	-	860
1982	30,700	180	236
1983	14,000	-	200
1984	13,500	50	50
1985	7,700	50	50
1986	12,000	-	100
Totals	214,900	8,392	2,515

Table 12: Summary of Dwarf Mistletoe Program Expenditures and Accomplishments for the White River National Forest (1981-86).

Fiscal Year	FPM $		Acres Surveyed	Acres Treated	
1981	15,900		4,000	-	
1982	20,400		3,000	120	
1983[1/]	-	(123,000)	-	-	(1,300)
1984	12,000		1,700	110	
1985	13,500		-	130	
1986	11,500		-	90	
Totals	73,300	(123,000)	8,700	450	(1,300)

[1/] Figures in parentheses funded by Jobs Bill.

DWARF MISTLETOE REPORTS--R-2 (1971-1985)

1971

Brown, D. 1971. Biological Evaluation. Proposed dwarf mistletoe projects, North Park Ranger District, Routt National Forest. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, 2 pp.

1972

Brown, D. 1972. Biological Evaluations. Dwarf Mistletoe, Routt National Forest, North Park Ranger District. USDA, For. Serv., Rocky Mountain Region, Division of Timber Management, 11 pp.

Brown, D. 1972. Biological Evaluation. Initial results of an administrative study of dwarf mistletoe survey methods. USDA For. Serv., Region 2, Division of Timber Management, 8 pp.

Brown, D. 1972. Biological Evaluation. Dwarf Mistletoe, Bighorn National Forest, Tongue Ranger District, July 1972. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-72-11, 3 pp.

Brown, D. 1972. Biological Evaluation. Dwarf Mistletoe, Bighorn National Forest, Tensleep Ranger District, Bull Creek Timber Sale, June 1972. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-72-12, 3 pp.

Brown, D. 1972. Biological Evaluation. Dwarf Mistletoe, Bighorn National Forest, Buffalo Ranger District, July 1972. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-72-13, 3 pp.

Brown, D. 1972. Biological Evaluation. Dwarf Mistletoe, Bighorn National Forest, Paintrock Ranger District, July 1972. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-72-14, 3 pp.

Brown, D. 1972. Post-Control Evaluation. Dwarf Mistletoe control projects, Routt National Forest, North Park Ranger District. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-72-24, 3 pp.

1973

Brown, D. 1973. An evaluation survey procedure for dwarf mistletoe in proposed thinning projects. USDA For. Serv., Region 2, Division of Timber Management, Denver, Colorado, 7 pp.

Brown, D. 1973. Biological Evaluation. Dwarf Mistletoe, Bighorn National Forest, Buffalo Ranger District. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-73-14, 10 pp.

Brown, D. 1973. Biological Evaluation. Dwarf Mistletoe, Glenwood Springs BLM District, Kremmling Area. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-73-15, 3 pp.

1973 (continued)

Brown, D. 1973. Biological Evaluation. Dwarf Mistletoe, Shoshone National Forest, Wind River Ranger District. USDA For. Serv., Rocky Mountain Region, Division of Timber Management, Report R2-73-16.

1974

Brown, D. H. 1974. Biological Evaluation, Dwarf Mistletoe. Arapaho and Roosevelt National Forests, Redfeather Ranger District. USDA For. Serv., Forest Pest Mgmt., Region 2, Report R2-74-6, 6 pp.

Landis, T. D. and R. H. Frye. 1974. Evaluation of potential hazard trees in recreation areas on the Dillon District, Arapaho National Forest. USDA For. Serv., Region 2, Report R2-74-7, 8 pp.

Walters, J. W. 1974. Importance of bole infections in spread of lodgepole pine dwarf mistletoe. Plant Disease Reporter 58: 1066-1069.

1975

Brown, D. H. 1975. Biological Evaluation. Dwarf Mistletoe, Arapaho and Roosevelt National Forests, Poudre Ranger District. USDA For. Serv., Rocky Mountain Region, Report R2-75-6, 12 pp.

Brown, D. H. 1975. Biological Evaluation. Dwarf Mistletoe, Clint Creek TSI Project, Shoshone National Forest, Wind River Ranger District. USDA For. Serv., Rocky Mountain Region, Forest Pest Mgmt., Report R2-75-28, 17 pp.

Brown, D. H. 1975. Biological Evaluation. Dwarf Mistletoe, Gunnison National Forest, Cebolla Ranger District. USDA For. Serv., Rocky Mountain Region, Forest Pest Mgmt., Report R2-75-5, 13 pp.

Brown, D. H. 1975. Pest control evaluations. Dwarf mistletoe control projects, Routt National Forest, North Park Ranger District. USDA For. Serv., Rocky Mountain Region, Forest Pest Management, Report R2-75-27, 47 pp.

Frye, R. H. and T. D. Landis. 1975. Mountain pine beetle and dwarf mistletoe, Lake Creek Area, San Carlos Ranger District, Pike and San Isabel National Forests. USDA For. Serv., State and Private Forestry, Forest Pest Mgmt., Region 2, Denver, CO, Bio. Eval. R2-75-4, 10 pp.

Landis, T. D. and D. W. Johnson. 1975. Mountain Home Tract, Wyoming State Forest Service, August 1975. USDA For. Serv., State and Private Forestry, Forest Pest Mgmt., Rocky Mountain Region, Bio. Eval. R2-75-19, 5 pp.

1976

Brown, D. H. 1976. Dwarf mistletoe, Arapaho and Roosevelt National Forests, Redfeather Ranger District, September 1974. USDA For. Serv., State and Private Forestry, Forest Pest Mgmt., Rocky Mountain Region, Bio. Eval. R2-76-1, 7 pp.

1976 (continued)

Cahill, D. B. and D. W. Johnson. 1976. Rawlins District, Bureau of Land Management, Green Mountains, Wyoming, July 1976. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Bio. Eval. R2-76-12, 10 pp.

Downing, G. L. 1976. 5230 Evaluations, Service Trip Appraisal Report 76-6, BLM-Green Mountains Wyoming. (Letter dated July 8, 1976.)

Downing, G. L. 1976. 5230 Evaluations, Service Trip Appraisal Report 76-12, Sulphur Ranger District, Arapaho National Forest. (Letter dated October 7, 1976.)

Johnson, D. W., L. C. Yarger, C. D. Minnemeyer, and V. E. Pace. 1976. Dwarf mistletoe as a predisposing factor for mountain pine beetle attack of ponderosa pine in the Colorado Front Range. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Tech. Rep. R2-4, 7 pp, plus appendix.

1977

Brown, D. H. 1977. Management guidelines for lodgepole pine stands infested with comandra blister rust and dwarf mistletoe. USDA For. Serv., Forest Pest Mgmt., Rocky Mountain Region, Tech. Rep. R2-9, 21 pp.

Downing, G. L. 1977. 5200 Forest Insect and Disease Control. Snowshoe Creek and Crooked Creek, Wind River Ranger District, Summary Data Sheets. (Letter dated July 7, 1977.)

Hawksworth, F. G., T. E. Hinds, D. W. Johnson, and T. D. Landis. 1977. Silvicultural control of dwarf mistletoe in young lodgepole pine stands. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Tech. Rep. R2-10, 9 pp, plus appendix.

Johnson, D. W. and C. D. Minnemeyer. 1977. Surveys of lodgepole pine stands for dwarf mistletoe and comandra rust, Wind River Ranger District, Shoshone National Forest, June 1977. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Bio. Eval. R2-77-8, 9 pp.

1978

Brown, D. H. 1978. Effects of thinning and pruning on the incidence of dwarf mistletoe in lodgepole pine. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Tech. Rep. R2-14, 7 pp.

Downing, G. L. 1978. 3430 Evaluations. Service Trip Appraisal Report 78-10, Evaluation of proposed overstory removal and thinning projects, Pierson Park, Estes Park Ranger District, Arapaho and Roosevelt National Forests. (Letter dated July 27, 1978.)

1978 (continued)

Downing, G. L. 1978. 3430 Evaluations. Service Trip Appraisal Report 78-13, Evaluation of dwarf mistletoe project proposals, White River National Forest. (Letter dated August 21, 1978.)

Downing, G. L. 1978. 3430 Forest Insect and Disease Evaluations. Service Trip Appraisal Report 78-16, Evaluation of dwarf mistletoe project proposals, Gunnison National Forest. (Letter dated September 7, 1978.)

Johnson, D. W. 1978. 5230 Evaluations. Service Trip Appraisal Report 78-4. Muddy Creek overstory removal, Buffalo Creek Ranger District, Bighorn National Forest. (Letter dated May 23, 1978.)

Johnson, D. W. 1978. Dwarf mistletoe surveys, Arapaho and Roosevelt National Forests, Redfeather Ranger District, December 1978. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Bio. Eval. R2-78-6, 23 pp.

Johnson, D. W. and F. G. Hawksworth. 1978. An evaluation survey procedure for proposed thinning projects in lodgepole pine stands infested with dwarf mistletoe. USDA For. Serv., Forest Insect and Disease Survey Methods (Manual), 5 pp. plus Appendix.

Johnson, D. W., F. G. Hawksworth, and D. B. Drummond. 1978. 1977 Dwarf mistletoe loss assessment survey, Medicine Bow National Forest, Wyoming. USDA For. Serv., Forest Insect and Disease Mgmt., Methods Application Group Report 78-1, 6 pp.

1979

Downing, G. L. 1979. Letter to State Forester, Wyoming State Forestry Division, dated August 27, 1979.

Johnson, D. W. 1979. 3430 Forest Insect and Disease Evaluations. Service Trip Appraisal Report 79-1. TSS Timber Sale Overstory Removal, Wind River Ranger District, Shoshone National Forest. (Letter dated May 23, 1979.)

Johnson, D. W. 1979. Dwarf mistletoe surveys, Bureau of Land Management, Craig District, Kremmling Resource Area, Colorado, May 1979. USDA For. Serv., State and Private Forestry, Forest Insect and Disease Mgmt., Rocky Mountain Region, Bio. Eval. R2-79-5, 10 pp.

Johnson, D. W., F. G. Hawksworth, and D. B. Drummond. 1979. 1978 Dwarf mistletoe loss assessment survey, Bighorn and Shoshone National Forests, Wyoming. USDA For. Serv., Forest Insect and Disease Mgmt., Methods Application Group Report No. 79-3, 8 pp.

1980

Downing, G. L. 1980. Letter to State Forester, Wyoming State Forestry Division, dated August 6, 1980.

1980 (continued)

Fuller, L. R. 1980. Dwarf mistletoe surveys, Bow River Section, Wyoming State Forestry Division 1980. USDA For. Serv., Forest Pest Mgmt., Rocky Mountain Region, Bio. Eval. R2-80-10, 18 pp.

Johnson, D. W. 1980. Evaluation of clearcut units for dwarf mistletoe control projects, Wind River Ranger District, Shoshone National Forest, February 1980. USDA For. Serv., Forest Insect and Disease Mgmt., Rocky Mountain Region, Bio. Eval. R2-80-3, 6 pp.

Johnson, D. W., F. G. Hawksworth and D. B. Drummond. 1980. 1979 Dwarf mistletoe loss assessment survey on National Forest lands in Colorado. USDA For. Serv., Forest Pest Mgmt., Methods Application Group Report No. 80-6, 18 pp.

1981

Downing, G. L. 1981. 3430 Evaluations. Service Trip Appraisal No. 81-11, Dwarf mistletoe project planning. (Letter dated November 2, 1981.)

Johnson, D. W., F. G. Hawksworth and D. B. Drummond. 1981. Yield loss of lodgepole pine stands to dwarf mistletoe in Colorado and Wyoming National Forests. Plant Disease 65: 437-438.

Lessard, G. D. and D. W. Johnson. 1981. Mountain pine beetle, dwarf mistletoe, comandra rust in lodgepole pine; Roaring Fork and North Fork drainages, Little Snake River, Medicine Bow National Forest--1981. USDA For. Serv., Forest Pest Mgmt., Rocky Mountain Region, Bio. Eval. R2-81-4, 20 pp.

1982

Downing, G. L. 1981. 3430 Evaluations. Service Trip Appraisal R2-82-6, Dwarf mistletoe planning, Holy Cross Ranger District. (Letter dated June 21, 1981.)

Downing, G. L. 1981. 3430 Evaluations. Service Trip Appraisal 82-10, Dwarf mistletoe planning, Middle Park Ranger District. (Letter dated November 5, 1981.)

Johnson, D. W. 1982. Dwarf mistletoe and mountain pine beetle, Middle Mountain and Diamond Peak, Little Snake Resource Area, Bureau of Land Management, Colorado, 1982. USDA For. Serv., Timber, Forest Pest and Cooperative Forestry Mgmt., Rocky Mountain Region, Bio. Eval. R2-82-6, 6 pp.

1983

Beavers, J. R. 1983. 3430 Evaluation. Service Trip Appraisal Report 83-4, Dwarf mistletoe project planning with BLM Canon City District office. (Letter dated July 25, 1983.)

1983 (continued)

Beavers, J. R. 1983. 3430 Evaluation. Service Trip Appraisal Report, 83-5, Dwarf mistletoe project planning and evaluation. (Letter dated September 22, 1983.)

Beavers, J. R. 1983. 3430 Evaluations. Service Trip Appraisal Report 83-6, Evaluation of pest problems on the Gunnison and Uncompahgre National Forests. (Letter dated October 11, 1983.)

Downing, G. L. 1983. 3430 Evaluations. Service Trip Appraisal Report 83-2, Meeting with ski area managers on vegetation management. (Letter dated May 12, 1983.)

Fuller, L. R. 1983. Incidence of root diseases and dwarf mistletoe in mountain pine beetle killed ponderosa pine in the Colorado Front Range. USDA For. Serv., Forest Pest Mgmt., Rocky Mountain Region, Bio. Eval. R2-83-2, 8 pp.

Haneman, D. M. 1983. Mountain pine beetle, Shirley Mountains, Wyoming, 1982. USDA For. Serv., Timber, Forest Pest and Cooperative Forestry Mgmt., Rocky Mountain Region, Bio. Eval. R2-83-3, 12 pp.

1984

Beavers, J. R. 1984. 3420 Evaluations. Service Trip Appraisal Report 84-5. Evaluation of proposed dwarf mistletoe control projects, King Mountain, Glenwood Springs Resource Area office, BLM. (Letter dated June 26, 1984.)

Beavers, J. R. 1984. 3420 Evaluations. Service Trip Appraisal Report 84-10. Evaluation of proposed dwarf mistletoe control projects, Canon City District. (Letter dated July 25, 1984.)

Beavers, J. R. 1984. 3420 Evaluations. Service Trip Appraisal Report 84-13. Evaluation of proposed dwarf mistletoe control projects, Del Norte Ranger District, Rio Grande National Forest. (Letter dated September 26, 1984.)

Beavers, J. R. 1984. 3420 Evaluations. Service Trip Appraisal Report 84-14. Overview of forest pest problems on the Bighorn National Forest. (Letter dated October 15, 1984.)

Johnson, D. W., F. G. Hawksworth, and L. M. Merrill. 1984. Ponderosa pine dwarf mistletoe loss assessment survey on National Forest lands in Colorado. USDA For. Serv., Timber, Forest Pest and Cooperative Forestry Mgmt., Rocky Mountain Region, Tech. Rep. R2-27, 13 pp.

1985

Beavers, J. R. 1985. 3420 Evaluations. Service Trip Appraisal Report 85-2. Evaluation of dwarf mistletoe in Stillwater and Cutthroat Bay Campgrounds, Lake Granby. (Letter dated April 15, 1985.)

1985 (continued)

Beavers, J. R. 1985. 3420 Evaluations. Service Trip Appraisal, Disease and Insect Conditions, Rio Grande National Forest. (Letter dated August 5, 1985.)

Johnson, D. W. and F. G. Hawksworth. 1985. Dwarf mistletoes. Candidates for control through cultural management, p. 48-55, In Insect and Disease Conditions in the United States 1979-83. R. C. Loomis, S. Tucker, and T. H. Hofacker, eds. USDA For. Serv., State and Private Forestry, Forest Pest Mgmt., Gen. Tech. Rep. WO-46, 93 pp.